

# Land Use Change in Riparian Buffers: Impacts on Erosion and Flood Risk in the Blue River Headwaters Subwatershed



Matthew Paulson, Scott Schulte\*, Tony Layzell†

\* MUP, ENV SP, University of Kansas

ተ Ph.D, Kansas Geological Survey

### Contact: matthewpaulson@ku.edu

#### Introduction

Headwater streams are an important but undervalued part of the watershed, and they can have an outsized impact on downstream flooding, water quality, and biodiversity. Over the past 20 years, Johnson County has been expanding south to cater to a growing population, often enclosing headwaters and encroaching into riparian vegetation buffers. This inprogress project investigates changes in riparian vegetation around the headwaters of the Blue River tributary to the Missouri River and evaluates associated increases in flood risk and erosion as identified in the Johnson County Watershed Phase 1 Master Plan published in 2022.<sup>2</sup>

Land use and cover data are used to determine where new developments have been built and quantifies changes in land use within Federal Emergency
Management Agency (FEMA) designated
1% flood zones and 30-meter riparian buffer zones between 2008 and 2024.

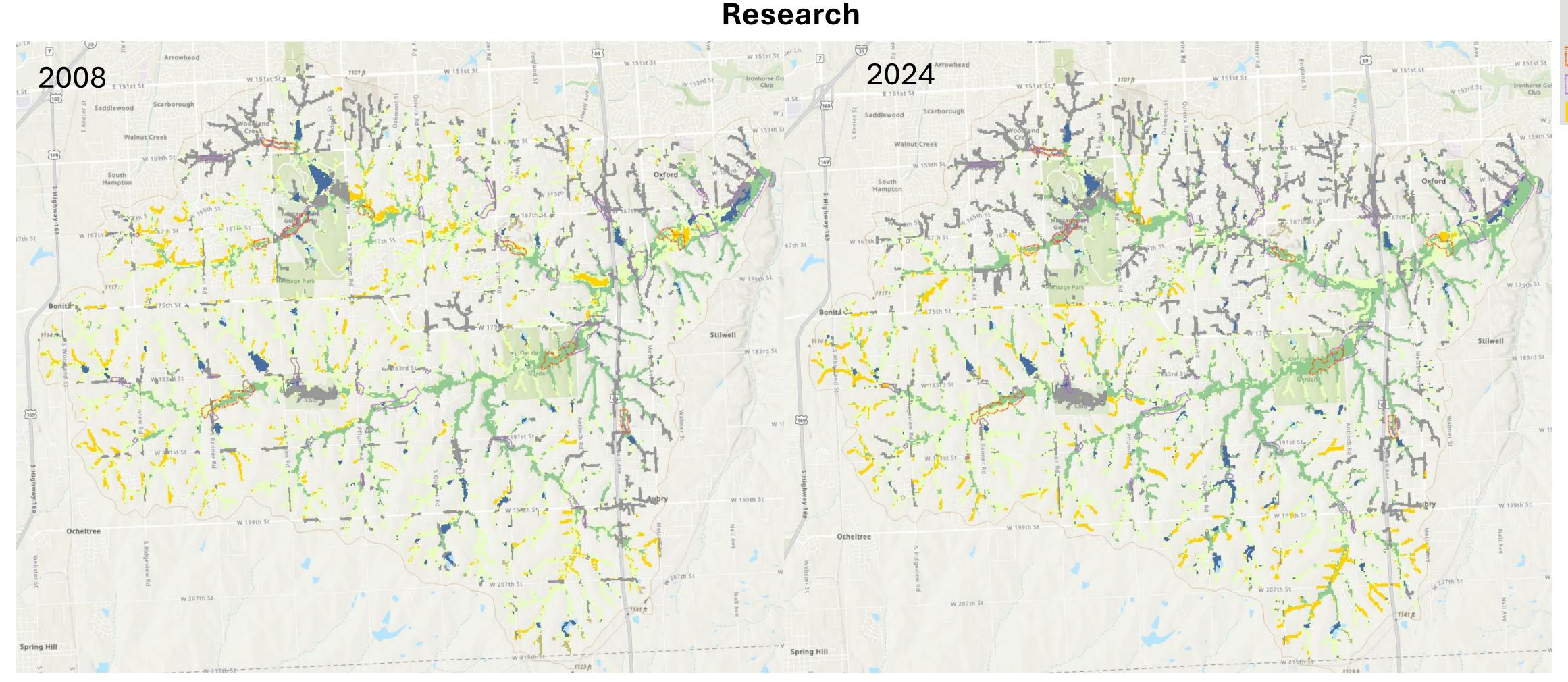


Figure 2 (Left). 2008 land cover map of the Blue River Headwaters Subwatershed, including Coffee Creek and Wolf Creek. 30-meter buffers from stream centerlines are added to flood areas. Outlined areas in red and purple indicate where the Johnson County Watershed Master Plan identified erosion and water quality issues. Figure 3 (Right). 2024 land cover map of same.

# Methodology

- 1. Collect land use data between 2008-2024 from USDA CroplandCROS, and 2020 LiDAR from the Johnson County Government.
- 2. Generate stream centerlines from the LiDAR using ArcHydro tools from ERSI in ArcGIS Pro.
- 3. Generate 30-meter riparian buffers using centerlines for headwaters streams above established FEMA flood hazard areas.
- 4. Process and interpret changes in land cover, and associate results with hazard areas identified in the Johnson County Phase 1 Watershed Master Plan.

# **Preliminary Results**

The summary of land use change is below in Table 1. In 16 years, developed area in riparian buffers has increased by 22 percent, while grassland and cropland decreased by -25% and -8% respectively.

Interestingly, the forest category has increased substantially but covers less total area than developed land in 2024. We suspect that the growth in forest results when former crop and pasture land are unmaintained prior to suburban development. The age, diversity, and potential benefits of this new growth forest will be evaluated, if possible.

Cover Within 30-meter Buffer	2008 (% of sum)	2024 (% of sum)	abs. % Change	% Change	2008 (acres)	2024 (acres)	Change (acres)
Crop	9	8	-1	-8	704	649	-55
Grassland/Pasture	48	36	-12	-25	4030	3043	-987
Forest	17	26	8	45	1472	2135	663
Developed	22	27	5	23	1855	2284	430

Table 1. Comparison of relative and absolute land use areas between 2008 and 2024 in the 30-meter riparian vegetation buffer. Negligible categories such as open water have been excluded for clarity.

# Legend Open Water Developed WaterQualityErosionHots Forest ErosionRiskAreas Grassland/Pasture Crops

#### **Discussion**

Vegetated riparian buffers have been substantially reduced in the past 16 years, and the newly developed land is consistently upstream of erosion risk areas and water quality hotspots identified in the Watershed Master Plan. However, only a qualitative correlation can be established from the data we have access to so far.

There has also been a notable increase in land classified as forest. However, based on biological assessment field surveys in the Blue River Watershed in Spring of 2025, we expect the new forest classification to be a mix of new growth trees and invasive shrub honeysuckle (which provides little benefit as a riparian buffer).<sup>3</sup>

More comprehensive historical elevation data and field surveys will be required to determine the extent of sediment loss and new vegetation characteristics.

#### **Next Steps**

Historical digital elevation models will be compared with recent data to quantify sediment loss from the watershed and surrounding areas and compared with risk areas highlighted in the Master Plan. Observed erosion and risk will be correlated with riparian buffer loss. We also will generate historical centerlines to evaluate channel modification and loss over time. A separate project at KU is working on quantifying invasive shrub honeysuckle from ariel imagery to better understand the composition and quality of forest growth.

## References

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  2. "Johnson County Phase 1 Watershed Master Plan Watershed 3." Olsson, March
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- 3. Rasmussen, Teresa J., Mandy S. Stone, Barry C. Poulton, and Jennifer L. Graham. "Quality of Streams in Johnson County, Kansas, 2002--10." *Scientific Investigations Report*, 2012, i–103. https://doi.org/10.3133/sir20125279.

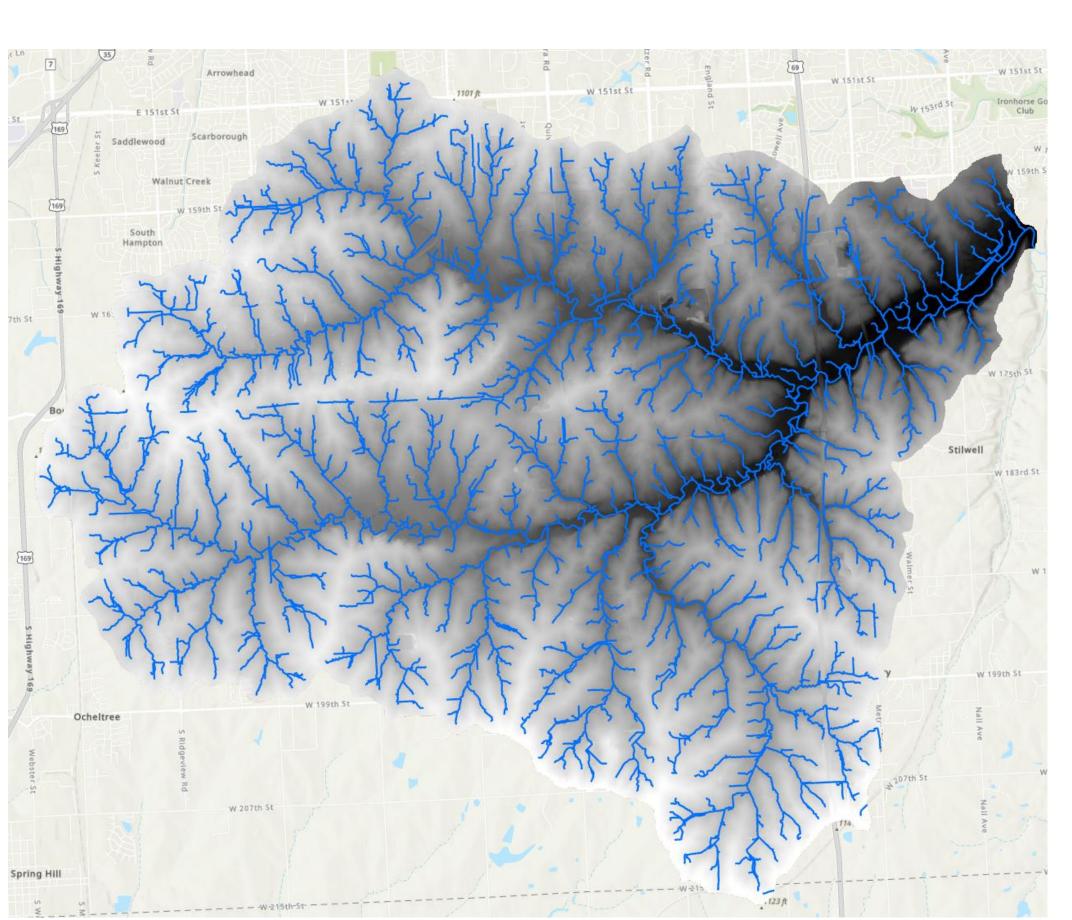


Figure 1. Digital elevation model of the Blue River Headwaters Subwatershed. Centerlines were generated using the ArcHydro toolset by ESRI using LiDAR flown in 2020 by Johnson County.

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Drainage area is 32,873 acres

Data source: <u>USGS Watershed Boundary Dataset</u>